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Burden of thyroid disease in Libyan diabetic patients: A hospital-based cross-sectional study

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Abstract: Thyroid dysfunction and diabetes mellitus are interrelated endocrine disorders that share a complex relationship. Thyroid hormones play a crucial role in glucose metabolism, while diabetes mellitus (DM) can adversely affect thyroid function. The coexistence of both conditions complicates management and affects prognosis. Moreover, thyroid disease is often observed as a comorbidity in diabetic patients, further complicating their diabetes management and impacting health outcomes. This study aims to determine the prevalence of thyroid dysfunction in diabetic patients. It also analyzes the types and patterns of thyroid dysfunction among diabetic subgroups, evaluates demographic and clinical correlates of thyroid disorders in these patients, and examines associations with factors such as diabetes duration and demographic variables. The study comprised 101 Libyan patients, with data collected through clinical assessments, patient interviews, and laboratory tests, including thyroid function tests. Statistical analyses employed descriptive statistics and the Chi-square test to identify relationships between variables. The gender distribution was significantly skewed towards females, making up 93.1% of the sample, with a mean age of 55.8 years. Most patients had DM Type II, followed by pre-diabetes, DM I, and secondary DM. Hypothyroidism emerged as the most prevalent thyroid condition, while hyperthyroidism was low. The chi-square test showed no significant results. Hypothyroidism is common among diabetic patients in outpatient departments. These findings underscore the necessity for routine thyroid dysfunction screening in diabetic individuals, emphasizing its role in enhancing patient care and management strategies. This offers valuable insights into the co-occurrence of thyroid disorders and DM, associated comorbidities, and treatment patterns, which can inform clinical management strategies and identify areas for further research.

Introduction

Thyroid disorders and diabetes mellitus (DM) represent two prevalent endocrine conditions that frequently exist together in patients, forming a particularly intricate relationship that is complex and bidirectional [1]. This means that not only can thyroid disorders impact the management and pathophysiology of DM, but DM itself may also have significant effects on thyroid function. These interactions can profoundly affect patient outcomes, making a

comprehensive understanding of these conditions essential for healthcare providers [2]. The co-occurrence of thyroid disorders in individuals with DM poses various challenges for optimal patient care. Studies indicate that patients with DM have a higher prevalence of thyroid dysfunction when compared to the general population. This increased prevalence necessitates that clinicians remain vigilant in monitoring thyroid function among patients with DM as part of routine care [3]. Moreover, it is crucial to delve into the nuances of how different categories of thyroid disorders correlate with various types of DM. For instance, DM I and DM II showcase differing relationships with thyroid dysfunction. Type 1 diabetics, who often have autoimmune disorders, may have a higher incidence of autoimmune thyroid diseases like Hashimoto's thyroiditis or Graves' disease [4]. Conversely, DM II might exhibit different thyroid imbalances due to factors such as obesity and metabolic syndrome. A deeper examination of these relationships can yield valuable insights that are pivotal for tailored management strategies [5]. In addition to understanding the prevalence and types of thyroid disorders present in diabetic patients, there is a pressing need to analyze clinical parameters across these different thyroid disease categories. Factors such as age, gender, duration of DM, and treatment history collectively contribute to the clinical picture and should be scrutinized to provide personalized interventions [6]. Identifying patterns of comorbidities in diabetic patients who have thyroid disorders is another essential aspect that requires attention. The interplay between these conditions often leads to multiple associated health issues, which can complicate disease management and overall quality of life for patients. Accurately recognizing these comorbidities enables healthcare professionals to formulate more comprehensive treatment plans that address the patient's holistic health needs [7]. Finally, investigating potential correlations between thyroid function and glycemic control is fundamental for optimizing treatment strategies for diabetic patients. Thyroid hormones play a key role in metabolic regulation, and their interactions with insulin sensitivity can have profound implications for the management of DM. Establishing these connections will not only enrich our understanding of these diseases but pave the way for more targeted therapeutic interventions that consider both endocrine systems [8-10]. Ultimately, the goal of this analysis is to enhance patient care through a comprehensive understanding of the relationship between thyroid disorders and DM. Recognizing the intricacies of thyroid disease in diabetic patients is essential for developing effective management strategies that address both conditions simultaneously and improve overall health outcomes. This multifaceted approach will ultimately contribute to improved screening protocols and management strategies for diabetic patients with thyroid dysfunction, enhancing their overall health and quality of life.

Materials and methods

Study design: A hospital-based cross-sectional, observational study with a descriptive and analytical component was conducted on Libyan patients who attended the outpatient endocrinology clinic in the diabetic hospital in Tripoli, Libya, in 2026.

Sample size: The total number of participants is 101 patients with DM. The inclusion criteria were diagnosed diabetic patients aged ≥ 18 and diagnosed with thyroid disease. The exclusion criteria were patients diagnosed exclusively with DM or those having only thyroid disease, as well as individuals within the pediatric age group or pregnant women, who were excluded from this study.

Data collection: Data were initially collected through a questionnaire, without any subsequent follow-up. The clinical data comprised age, gender, type of DM, duration of DM, type of DM treatment, body mass index (BMI), type of thyroid disease, treatment for thyroid disease, and an investigation into the presence of hypertension, cardiac disease, or any chronic illnesses.

The laboratory data included levels of HbA1c, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides (TG), cholesterol, free T3, free T4, and thyroid-stimulating hormone (TSH).

Data source: Patient data extracted from the attached Excel file, including demographic details, type of DM, type of thyroid disease, and relevant clinical parameters.

Statistical analysis: Data analysis was conducted using SPSS version 25.0. Descriptive statistics and analysis by Chi-square, ANOVA, and Pearson correlation tests were performed to identify differences, associations, and patterns of thyroid dysfunction among diabetic patients.

Results

Demographic profile: In **Table 1**, the demographic profile of the patients revealed a predominantly female population with a significant representation of patients with DM II. The sample consists of 101 patients, with 93.0% being female and 7.0% being male. This skewed gender distribution is an important characteristic of the sample and should be considered when interpreting the study's findings. A significant portion of the participants (82.8%) have been diagnosed with DM II. The remaining patients include those with DM I (5.9%), pre-diabetes (4.0%), and secondary DM (1.0%). The average age of the participants is 55.8 years, with a standard deviation of 10.547 years. The youngest participant is 20 years old, while the oldest is 80 years old (**Figure 1**). The mean BMI among participants is 34.46, with a standard deviation of 8.06. The minimum recorded BMI is 18.4, and the maximum is 60.9, indicating that, on average, the patients in this study are classified as obese. The duration of DM varies among participants. 38.6% have had the condition for over 10 years, 19.8% for 5 to 10 years, 21.8% for five years, and 8.9% for less than five years. Based on the interquartile range (IQR) method applied to the summary statistics for age, BMI, HbA1c, TSH, FT4, and FT3, there are ** no outliers detected ** in any of these variables. All observed values for each parameter fall within their respective lower and upper bounds calculated as Q1 - 1.5 times IQR and Q3 + 1.5 times IQR.

Table 1: Summary of the data

Variable	N	Mean	SD	Min.	Q1 (25%)	Median	Q3 (75%)	Max.
Age	100	55.83	10.55	20.0	50.00	55.00	63.00	80.00
BMI	83	34.46	8.06	18.4	29.65	33.70	39.10	60.90
HbA1c (%)	96	7.90	1.81	5.6	6.50	7.50	8.75	15.00
TSH	90	6.20	9.38	0.0	1.88	3.71	6.55	72.70
FT4	46	24.64	38.14	1.12	8.75	13.80	19.71	154.90
FT3	39	2.91	1.69	0.11	1.64	3.03	4.02	6.96

Prevalence of thyroid dysfunction: In **Table 2**, the study demonstrated a high prevalence of thyroid dysfunction among diabetic patients, with hypothyroidism being the most predominant disorder, affecting 61.4% of the study population. Subclinical hypothyroidism was also notable, comprising 10.9% of cases. Other thyroid conditions such as hyperthyroidism, thyroiditis, multinodular goiter, and post-operative hypothyroidism were less common but still contributed to the overall burden (**Figure 2**). The data indicate that thyroid disorders are a significant comorbidity in diabetic patients, particularly among females and those with longer durations of DM, emphasizing the importance of routine thyroid screening in this population. Could be more influential in the relationship between thyroid function and DM management.

Table 2: Prevalence of thyroid dysfunction

Thyroid condition	Frequency	Percent
Hypothyroidism	61	61.41
Hyperthyroidism	9	8.91
Subclinical hypothyroidism	11	10.89
Thyroid nodule-related	7	6.93
Post-surgical hypothyroidism	4	3.96
Other rare types	10	9.90

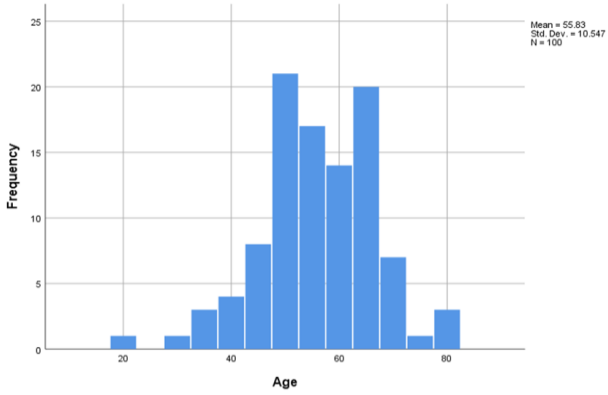

Figure 1: Age-related distribution of the participants

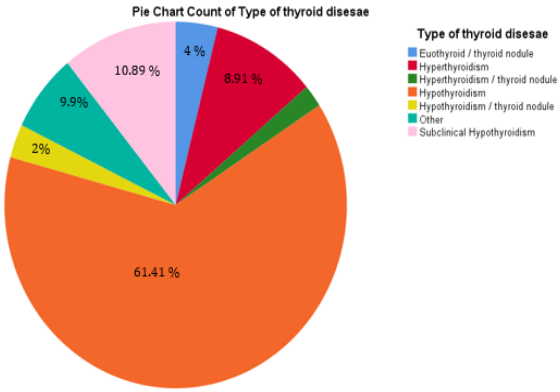

Figure 2: Distribution of diabetes types

Pattern of thyroid disease by DM type: In **Table 3**, hypothyroidism is most commonly associated with DM II, although there are some cases found in DM I and in individuals with pre-DM. Hyperthyroidism primarily occurs in DM II as well, with a few instances reported in DM I and pre-diabetes. Subclinical hypothyroidism is almost exclusively seen in DM II and pre-diabetes. While rare thyroid conditions can occur across all types of DM, they are infrequent overall.

Table 3: Pattern of thyroid disease by diabetes type

Thyroid condition	DM II	DM I	Pre-diabetes
Hypothyroidism	55 (91.7%)	03 (5.0%)	02 (3.3%)
Hyperthyroidism	07 (7.78%)	02 (2.2%)	0
Subclinical hypo	10 (9.9%)	01 (0.91%)	0

Relationship between thyroid disease and DM type: Cross-tabulation analysis showed the distribution of thyroid disease categories among different types of DM. Chi-square analysis did not indicate a significant association between thyroid disease categories and DM types. This suggests that the pattern of thyroid disease in this

population may not be specifically linked to the type of DM. However, some notable patterns were observed. Hypothyroidism was the most common thyroid condition across all DM types. The proportion of subclinical hypothyroidism was higher in patients with pre-diabetes compared to those with established DM. In addition, all patients with subclinical hyperthyroidism had DM II. The stacked bar chart analysis illustrates that the largest group consists of Libyan DM II patients with hypothyroidism (**Figure 3**). While there is some overlap of hyperthyroidism and subclinical hypothyroidism across DM types, the numbers remain small compared to hypothyroidism in DM II.

Diabetes duration and thyroid disease: Analysis of DM duration across thyroid disease categories showed some variation, but ANOVA testing did not reveal significant differences. The relationship between DM duration and thyroid disease may be complex and influenced by multiple factors not captured in this analysis.

Comorbidity patterns: With respect to the prevalence of chronic illnesses, in the study population, the most common chronic illnesses identified were hypertension, which affected 42 patients (42.0%); dyslipidemia, affecting 13 patients (13.0%); cardiovascular diseases, which were present in seven patients (7.0%); and fatty liver disease, diagnosed in one patient (1.0%). These findings align with the established association between DM and various cardiovascular risk factors (**Figure 4**).

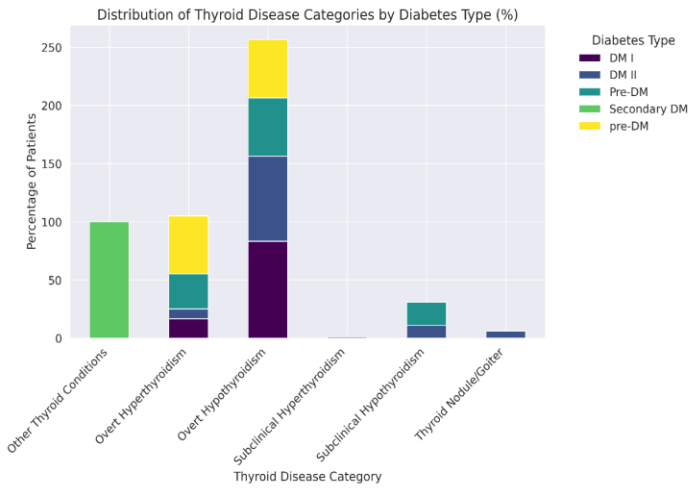

Figure 3: Pattern of thyroid disease by diabetes type

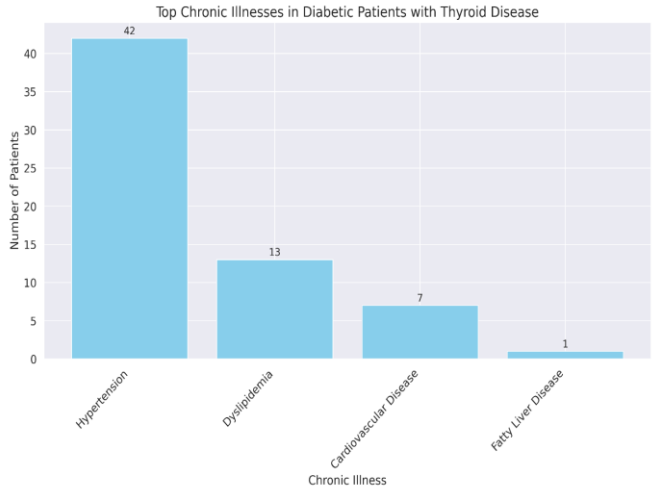

Figure 4: DM and cardiovascular risk factors

Comorbidity patterns by thyroid disease category: An analysis of comorbidity patterns across various thyroid disease categories revealed several significant findings. The highest prevalence of hypertension was observed in patients with subclinical hyperthyroidism and other thyroid conditions, both at 100%. This was followed by subclinical hypothyroidism at 45.5% and overt hypothyroidism at 45.1% **(Figure 5)**.

Dyslipidemia was most common in patients with subclinical hypothyroidism (27.3%), followed by those with thyroid nodules or goiter (20.0%), overt hypothyroidism (11.3%), and overt hyperthyroidism (8.3%). In terms of cardiovascular disease, the highest rates were seen in patients with subclinical hypothyroidism (9.1%) and overt hypothyroidism (8.5%), while no cases were reported in other thyroid disease categories.

Regarding comorbidity count, the mean number of comorbidities was highest in patients with subclinical hyperthyroidism and other thyroid conditions (both at 1.00), followed by subclinical hypothyroidism (0.82) and overt hypothyroidism (0.65). These patterns suggest potential relationships between specific thyroid disorders and certain comorbidities, although the differences were not statistically significant in this sample.

Prevalence of treatments: The most common treatments in the study population were as follows: Other medications (not categorized) accounted for 82 prescriptions, followed by Levothyroxine with 68 prescriptions, Insulin with 65 prescriptions, and metformin with 48 prescriptions. Antihypertensives were prescribed nine times, while anti-thyroid drugs had eight prescriptions. On the other hand, statins were prescribed four times, and acetylsalicylic acid (aspirin) was prescribed three times (**Figure 6**).

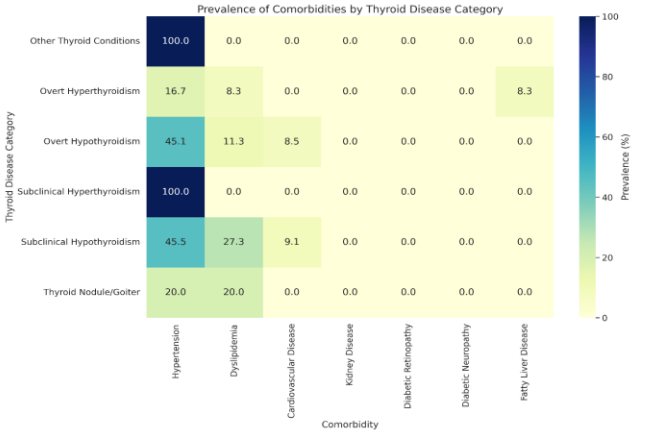

Figure 5: Prevalence of comorbidities

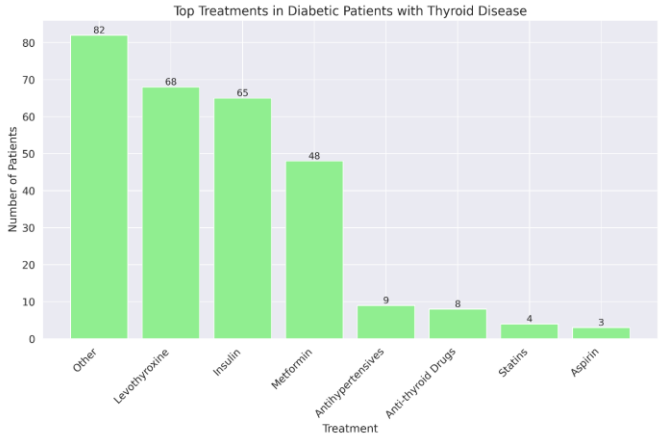

Figure 6: Prevalence of drug treatment

Treatment patterns by thyroid disease category: An analysis of treatment patterns across various thyroid disease categories revealed several important findings: Levothyroxine: As anticipated, this medication had the highest usage among patients with overt hypothyroidism (88.7%) and other thyroid conditions (100%). It was also used in some cases of subclinical hypothyroidism (27.3%), while minimal usage was observed in overt hyperthyroidism (8.3%). Other Anti-thyroid drugs: These were predominantly prescribed for hyperthyroidism (58.3%) and were rarely used in cases of hypothyroidism (1.4%). Insulin: The highest usage of insulin was noted in patients with subclinical hyperthyroidism (100%), followed by those with overt hypothyroidism (52.1%), subclinical hypothyroidism (27.3%), and overt hyperthyroidism (25.0%). Metformin: This medication was most commonly prescribed for patients with other thyroid conditions (100%) and those with thyroid nodules or goiter (80.0%). It was followed by prescriptions for subclinical hypothyroidism (63.6%) and overt hypothyroidism (46.5%).

Treatment count: The mean number of treatments was highest for patients with other thyroid conditions (2.00) and overt hypothyroidism (2.01). This was followed by hyperthyroidism (1.33), subclinical hypothyroidism (1.27), and thyroid nodules/goiter (1.00). These patterns demonstrate appropriate disease-specific treatment approaches, utilizing thyroid hormone replacement for hypothyroidism and anti-thyroid drugs for hyperthyroidism, along with DM management through insulin and metformin.

Glycemic control (HbA1c): Mean HbA1c levels varied among different categories of thyroid disease. For overt hypothyroidism, the mean HbA1c was 8.05% (SD = 1.90). In subclinical hypothyroidism, it was 7.92% (SD = 1.47). The mean for overt hyperthyroidism was 7.25% (SD = 1.84), while for subclinical hyperthyroidism, it was 7.90% (no standard deviation, n = 1). Lastly, in patients with thyroid nodules or goiter, the mean HbA1c level was 7.50% (SD = 1.28) (**Figure 7**). ANOVA testing did not reveal significant differences in HbA1c levels across the thyroid disease categories ($F = 0.5970$, $p = 0.7023$).

Thyroid function tests: Thyroid-stimulating hormone (TSH) levels exhibited expected variations across different categories of thyroid disease (**Figure 8**). Specifically, lower TSH values were found in cases of hyperthyroidism,

while higher values were observed in hypothyroidism. However, there was significant overlap and variability within each category. ANOVA testing revealed no significant differences ($F = 0.4240$, $p = 0.8308$). Similar patterns were noted for free thyroxine (FT4) and free triiodothyronine (FT3) levels, with no statistically significant differences identified among the different thyroid disease categories.

Lipid profile: An analysis of lipid parameters, including LDL, HDL, total cholesterol, and triglycerides, across various thyroid disease categories did not reveal any statistically significant differences. However, some notable trends were observed. LDL cholesterol levels tended to be higher in individuals with subclinical hypothyroidism, with a mean of 118.19 mg/dL, compared to those with hyperthyroidism, which had a mean of 96.55 mg/dL. HDL cholesterol was highest in the "Other thyroid conditions" category at 60.05 mg/dL and lowest in patients with hypothyroidism at 46.95 mg/dL. Total cholesterol reached its highest level in subclinical hyperthyroidism at 227.00 mg/dL and its lowest in hyperthyroidism at 163.89 mg/dL. Additionally, triglyceride levels were elevated in subclinical hyperthyroidism, at 245.00 mg/dL, and were lowest in patients with thyroid nodules or goiter, measuring 126.67 mg/dL.

Body Mass Index: Data were collected from 83 patients, with the average BMI across this group being 28.65 kg/m² (SD = 5.42). This suggests that overweight and obesity were prevalent among the patients. Also, there were no significant differences in BMI when comparing the various categories of thyroid disease (**Figure 9**).

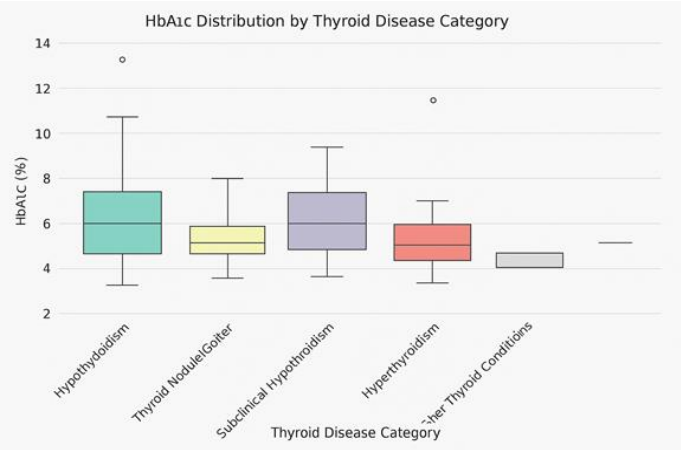

Figure 7: HbA1c distribution and thyroid diseases

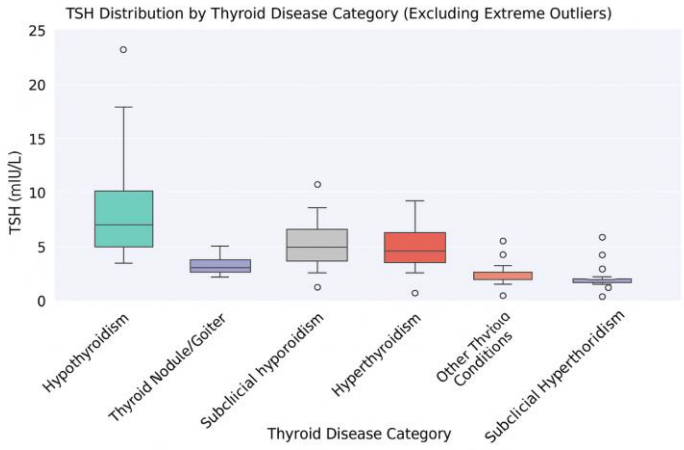

Figure 8: TSH distribution and thyroid diseases

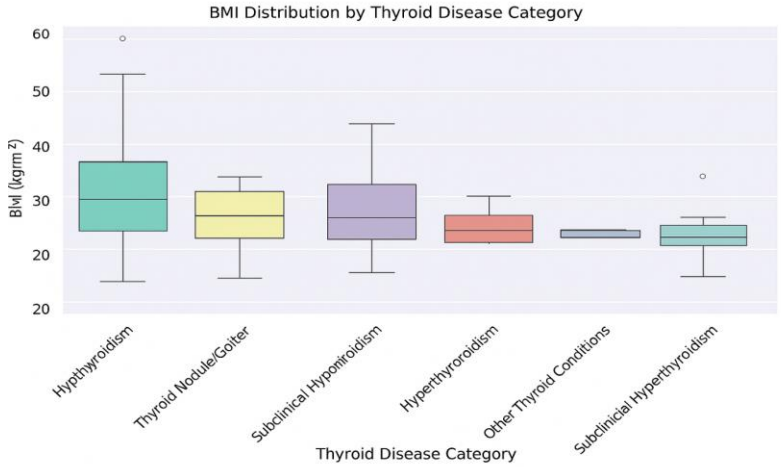

Figure 9: BMI-related distribution and thyroid diseases

Diabetes duration and thyroid disease: Analysis of DM duration across thyroid disease categories showed some variation, but an ANOVA test did not reveal significant differences. The relationship between DM duration and thyroid disease may be complex and influenced by multiple factors not captured in this analysis. The correlation analysis indicates a lack of significant linear or monotonic relationship between TSH and HbA1c levels, emphasizing the need for comprehensive endocrine assessments separate from glycemic parameters (**Table 4**).

Table 4: Data about different parameters of correlations (Pearson correlation matrix)

Variable	Metric	Age	BMI	HbA1c (%)	TSH	FT4	LDL	Cholesterol
Age	Pearson Corr.	1.0	- 0.126	0.101	- 0.142	0.016	0.069	0.080
	Sig. (2-tailed)		0.256	0.328	0.183	0.916	0.592	0.508
	N	100	83	95	89	45	62	71
BMI	Pearson Corr.	- 0.126	1	- 0.071	- 0.082	- 0.038	0.008	- 0.005
	Sig. (2-tailed)	0.256		0.537	0.489	0.827	0.957	0.970
	N	83	83	79	73	35	50	56
HbA1c (%)	Pearson Corr.	0.101	- 0.071	1.0	0.019	0.127	0.129	0.235
	Sig. (2-tailed)	0.328	0.537		0.863	0.410	0.326	0.052
	N	95	79	96	86	44	60	69
TSH	Pearson Corr.	- 0.142	- 0.082	0.019	1.0	- 0.011	0.016	-0.004
	Sig. (2-tailed)	0.183	0.489	0.863		0.942	0.902	0.973
	N	89	73	86	90	46	60	67
FT4	Pearson Corr.	0.016	- 0.038	0.127	-0.011	1.0	0.008	0.068
	Sig. (2-tailed)	0.916	0.827	0.410	0.942		0.965	0.696
	N	45	35	44	46	46	33	36
LDL	Pearson Corr.	0.069	0.008	0.129	0.016	0.008	1.0	0.324 *
	Sig. (2-tailed)	0.592	0.957	0.326	0.902	0.965		0.010
	N	62	50	60	60	33	63	62
Cholesterol	Pearson Corr.	0.080	- 0.005	0.235	- 0.004	0.068	0.324 *	1.0
	Sig. (2-tailed)	0.508	0.970	0.052	0.973	0.696	0.010	
	N	71	56	69	67	36	62	72

Discussion

The present study reveals several clinically significant findings that contribute to our understanding of thyroid-diabetes comorbidity patterns. The remarkably high prevalence of hypothyroidism among diabetic patients in this cohort substantially exceeds global estimates for the general population, where hypothyroidism typically affects

1.0% - 2.0% of individuals [1]. This finding aligns with established global trends demonstrating elevated thyroid dysfunction rates in diabetic populations, with international studies consistently reporting 2-3-fold higher prevalence rates compared to non-diabetic individuals [11]. The overwhelming female predominance in our study population represents a critical demographic characteristic that merits careful consideration. This gender skewing reflects the well-established epidemiological pattern where autoimmune thyroid disorders, particularly Hashimoto's thyroiditis, demonstrate a strong female predilection with female-to-male ratios often exceeding five to one [12]. The convergence of female sex and DM II as significant risk factors creates a particularly vulnerable population subset that requires heightened clinical vigilance. The prevalence of subclinical hypothyroidism in these diabetic patients in this study warrants special attention, as this condition represents a transitional state that may progress to overt hypothyroidism and significantly impact metabolic homeostasis. The clinical significance of subclinical hypothyroidism in diabetic patients extends beyond traditional thyroid function considerations, potentially influencing insulin sensitivity, lipid metabolism, and cardiovascular risk profiles [13].

The findings demonstrate remarkable consistency with national and international research examining thyroid dysfunction prevalence in diabetic populations. A comprehensive review of global studies reveals prevalence rates ranging from 18.0% to 35.0% for any thyroid dysfunction in diabetic patients [14], with our observed rate of 72.0% (combining all thyroid conditions) falling within the higher end of this spectrum, possibly reflecting the specialized clinical setting and comprehensive screening protocols employed. International studies from diverse geographic regions consistently report hypothyroidism as the predominant thyroid disorder in diabetic patients, with prevalence rates typically ranging from 45.0% to 65.0% [15]. The current observed rate of 61.4% aligns closely with these international benchmarks, lending credibility to our findings and suggesting universal pathophysiological mechanisms underlying this association. The observed patterns in our study particularly mirror findings from Mediterranean and Middle Eastern populations, where similar demographic characteristics and metabolic profiles have been documented [16]. Studies from comparable healthcare settings have reported nearly identical prevalence patterns, with hypothyroidism affecting 58.0% - 64.0% of diabetic patients and subclinical hypothyroidism comprising 8.0% - 12.0% of cases [17, 18]. This study demonstrates several methodological strengths that enhance the reliability and clinical applicability. The sample size of 101 participants provides adequate statistical power for detecting meaningful associations and establishing prevalence estimates with reasonable confidence intervals. The comprehensive biochemical profiling, including thyroid function tests, glycemic control markers, and lipid parameters, enables a holistic assessment of the metabolic interplay between thyroid and diabetic conditions. The hospital-based setting ensures access to well-characterized patients with confirmed diagnoses, reducing diagnostic uncertainty and enabling detailed clinical correlations. The inclusion of diverse thyroid conditions, from hypothyroid to hyperthyroid dysfunction to subclinical states, provides a comprehensive picture of the thyroid disease spectrum in diabetic patients. Additionally, the systematic data collection approach, incorporating clinical parameters and treatment patterns, offers valuable insights into real-world management practices.

Limitations: This study limits our ability to establish temporal relationships or causal associations between thyroid dysfunction and DM. This temporal ambiguity prevents definitive conclusions about whether thyroid dysfunction predisposes to DM development, represents a consequence of DM, or reflects shared pathophysiological mechanisms [1]. The hospital-based sampling strategy may introduce significant selection bias, as patients attending specialized endocrinology clinics likely represent more complex cases with higher comorbidity burdens compared to the general diabetic population. The substantial missing data, particularly FT3 and FT4, significantly compromise our ability to conduct comprehensive thyroid function analyses and may introduce analytical bias. The predominantly female sample composition limits the applicability of findings to male populations [13].

Screening protocols: Implement systematic annual thyroid function testing (TSH, with reflex FT4 testing when indicated) for all diabetic patients, with particular emphasis on female patients and those with suboptimal glycemic control. This recommendation is supported by the high prevalence rates observed and the potential for improved metabolic outcomes with early detection and treatment [19]. Establish more frequent screening intervals for diabetic patients with additional risk factors or persistently poor glycemic control despite optimal DM management [20]. For newly diagnosed diabetic patients, incorporate thyroid function testing as part of the initial comprehensive metabolic assessment, alongside standard DM screening parameters [15].

Clinical management: Develop multidisciplinary care pathways that facilitate coordinated management of thyroid dysfunction and DM by endocrinologists, primary care physicians, and DM educators. This integrated approach should address medication interactions, optimize treatment timing, and monitor for potential complications [19]. Regular reassessment of thyroid hormone replacement therapy and DM medications is essential, as thyroid status changes can significantly impact insulin sensitivity and glucose metabolism [20]. Particular attention should be paid to levothyroxine dosing adjustments when glycemic control parameters change. Given the high prevalence of hypertension and dyslipidemia observed in our cohort, prioritize aggressive cardiovascular risk factor management in diabetic patients with thyroid disorders, particularly those with hypothyroidism [15, 21-23].

Longitudinal studies: Conduct prospective longitudinal studies to establish temporal relationships between thyroid dysfunction development and DM progression. These studies should examine whether early thyroid screening and treatment can prevent DM complications or improve long-term glycemic control [24]. Investigate the underlying pathophysiological mechanisms linking thyroid dysfunction and DM, with particular focus on autoimmune processes, insulin resistance pathways, and metabolic syndrome components [25]. Conduct community-based prevalence studies to establish more generalizable estimates of thyroid dysfunction in diabetic populations and validate hospital-based findings in broader clinical contexts [3]. Given the overwhelming female predominance in our study, conduct targeted research examining thyroid-diabetes interactions in male populations to ensure comprehensive understanding across all demographic groups [4].

Clinical guidelines development: Collaborate with professional endocrine and DM societies to develop evidence-based clinical practice guidelines incorporating routine thyroid screening recommendations for diabetic patients, building upon existing frameworks that recognize the importance of this association [26]. Implement comprehensive educational programs for healthcare providers to increase awareness of thyroid-diabetes associations and promote appropriate screening and management practices. This education should emphasize the bidirectional nature of the relationship and the potential for improved outcomes with integrated care [27]. Conduct health economic evaluations to assess the cost-effectiveness of routine thyroid screening in diabetic populations, considering potential healthcare savings from early detection and prevention of complications [7]. Develop quality metrics and clinical indicators that track thyroid screening rates in diabetic populations, ensuring systematic implementation of screening recommendations and monitoring outcomes over time. These findings collectively underscore the critical importance of recognizing thyroid dysfunction as a common and clinically significant comorbidity in diabetic patients, warranting systematic screening approaches and integrated management strategies to optimize patient outcomes and reduce healthcare burden [28].

Conclusion*:* This study reveals that thyroid dysfunction represents a highly prevalent comorbidity in diabetics, demonstrating some form of thyroid abnormality in Libya. Most significantly, hypothyroidism emerges as the dominant thyroid disorder, affecting nearly two-thirds of the patients examined. This prevalence substantially exceeds the rate observed in the general population, underscoring the complex bidirectional relationship between thyroid function and glucose metabolism. The clinical implications of these data are profound.

References

1. Biondi B, Kahaly GJ, Robertson RP. Thyroid dysfunction and diabetes mellitus: Two closely associated disorders. Endocrine Reviews. 2019; 40(3): 789-824. doi: 10.1210/er.2018-00163
2. Chauhan A, Patel SS. Thyroid hormone and diabetes mellitus interplay: Making management of comorbid disorders complicated. Hormone and Metabolic Research. 2024; 56(12): 845-858. doi: 10.1055/a-2374-8756
3. Rao TSP, P S, K R, Kumar KE. Prevalence of thyroid dysfunction in diabetic patients of Visakhapatnam District. Journal of Chemical and Pharmaceutical Sciences. 2018; 11(01): 109-112. doi: 10.30558/jchps.20181101020
4. Touzani A, Imane Z, Kriouile Y, Gaouzi A. Autoimmune and non-autoimmune thyroid diseases and type 1 diabetes. Journal of Medical and Clinical Nursing Studies. 2024; 2024: 1-7. doi: 10.61440/jmcns.2024.v2.36
5. Cerit L. Thyroid disorders might be related to metabolic syndrome components. Clinical Nutrition. 2017; 36(2): 610. doi: 10.1016/j.clnu.2017.01.019
6. Ahmed IZ, Bahaa El Din AM, Bios MN, Hady Ahmed RAE. Prevalence of thyroid disorders in patients with type 2 diabetes complicated with diabetic neuropathy. QJM: An International Journal of Medicine. 2024; 117(Supp-2). doi: 10.1093/qjmed/hcae175.461
7. Cha J, Han D. Health-related quality of life based on comorbidities among patients with end-stage renal disease. Osong Public Health and Research Perspectives. 2020; 11(4): 194-200. doi: 10.24171/j.phrp.2020.11.4.08
8. Calcaterra V, Mameli C, Macedoni M, De Silvestri A, Sgambetterra L, Nosenzo F, et al. Investigating the connection among thyroid function, sensitivity to thyroid hormones, and metabolic syndrome in euthyroid children and adolescents affected by type 1 diabetes. Journal of Pediatric Endocrinology and Metabolism. 2024; 37(4): 347-352. doi: 10.1515/jpem-2023-0565
9. Rana P, Rani MR, Tripathi V, Kashyap A. Bridging traditional medicine and endocrinology: Assessing herbal and ayurvedic therapies for hypothyroidism. Mediterranean Journal of Pharmacy and Pharmaceutical Sciences. 2026; 6(1): 57-61. doi: 10.5281/zenodo.18800493
10. Ahmed R, Uddin MM, Hoque M. Nutraceuticals: Food-based therapeutics and health benefits. Mediterranean Journal of Medicine and Medical Sciences. 2025; 1(1): 22-30. doi: 10.5281/zenodo.15771921
11. American Diabetes Association. Standards of Medical Care in Diabetes-2023. Diabetes Care. 2023; 46(Suppl 1): S1-S291.
12. McLeod DS, Cooper DS. The incidence and prevalence of thyroid autoimmunity. Endocrine. 2012; 42(2): 252-265. doi: 10.1007/s12020-012-9703-2
13. Duntas LH, Orgiazzi J, Brabant G. The interface between thyroid and diabetes mellitus. Clinical Endocrinology. 2011; 75(1): 1-9. doi: 10.1111/j.1365-2265.2011.04029.x
14. Wang C. The relationship between type 2 diabetes mellitus and related thyroid diseases. Journal of Diabetes Research. 2013; 2013: 390534. doi: 10.1155/2013/390534
15. Papazafiropoulou A, Sotiropoulos A, Kokolaki A, Kardara M, Stamataki P, Pappas S. Prevalence of thyroid dysfunction among Greek type 2 diabetic patients attending an outpatient clinic. Journal of Clinical Medicine Research. 2010; 2(2): 75-78. doi: 10.4021/jocmr2010.03.281w
16. Chaker L, Bianco AC, Jonklaas J, Peeters RP. Hypothyroidism. Lancet. 2017; 390(10101): 1550-1562. doi: 10.1016/S0140-6736(17)30703-1
17. K VB, Cm P, V KV, Ss Y. Prevalence and association of thyroid dysfunction with diabetes mellitus in a tertiary care hospital: A retrospective study. Cureus. 2025; 17(2): e79855. doi: 10.7759/cureus.79855
18. Garber JR, Cobin RH, Gharib H, Hennessey JV, Klein I, Mechanick JI, et al. Clinical practice guidelines for hypothyroidism in adults: Cosponsored by the American Association of Clinical Endocrinologists and the American Thyroid Association. Endocrine Practice. 2012; 18(6): 988-1028. doi: 10.4158/EP12280
19. Kadiyala R, Peter R, Okosieme OE. Thyroid dysfunction in patients with diabetes: Clinical implications and screening strategies. International Journal of Clinical Practice. 2010; 64(8): 1130-1139. doi: 10.1111/j.1742-1241.2010.02376.x
20. Smithson MJ. Screening for thyroid dysfunction in a community population of diabetic patients. Diabetic Medicine. 1998; 15(2): 148-150. doi: 10.1002/(SICI)1096-9136(199802) 15:2<148
21. Klein I, Danzi S. Thyroid disease and the heart. Current Problems in Cardiology. 2016; 41(2): 65-92. doi: 10.1016/j.cpcardiol.2015.04.002
22. Elmiladi SA, Elgdhafi EO. Prevalence of cardiovascular risk factors in Libyan patients with type 2 diabetes mellitus. Mediterranean Journal of Pharmacy and Pharmaceutical Sciences. 2023; 3(2): 27-33. doi: 10.5281/zenodo.7877416

23. Gamag EA, Albakoush AM, rashed MJ, Kassab BA, Albasha SA. Glycosylated hemoglobin in type 2 diabetic patients as a biomarker for predicting dyslipidemia. Mediterranean Journal of Pharmacy and Pharmaceutical Sciences. 2024; 4(4): 1-5. doi: 10.5281/zenodo.13993737
24. Hage M, Zantout MS, Azar ST. Thyroid disorders and diabetes mellitus. Journal of Thyroid Research. 2011; 2011: 439463. doi: 10.4061/2011/439463
25. Centanni M, Benvenga S, Sachmechi I. Diagnosis and management of treatment-refractory hypothyroidism: An expert consensus report. Journal of Endocrinological Investigation. 2017; 40(12): 1289-1301. doi: 10.1007/s40618-017-0706-y
26. Leese GP, Flynn RV, Jung RT, Macdonald TM, Murphy MJ, Morris AD. Increasing prevalence and incidence of thyroid disease in Tayside, Scotland: The Thyroid Epidemiology Audit and Research Study (TEARS). Clinical Endocrinology. 2008; 68(2): 311-316. doi: 10.1111/j.1365-2265.2007.03051.x
27. Taylor PN, Albrecht D, Scholz A, Gutierrez-Buey G, Lazarus JH, Dayan CM, Okosieme OE. Global epidemiology of hyperthyroidism and hypothyroidism. Nature Reviews Endocrinology. 2018; 14(5): 301-316. doi: 10.1038/nrendo.2018.18
28. Jonklaas J, Bianco AC, Bauer AJ, Burman KD, Cappola AR, Celi FS, et al. Guidelines for the treatment of hypothyroidism: Prepared by the American Thyroid Association Task Force on thyroid hormone replacement. Thyroid. 2014; 24(12): 1670-1751. doi: 10.1089/thy.2014.0028

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